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From: Arje Nachman@ngNM
Originated by: Bill Kath <kath@asp.esam.nwu.edu>
Cc:
Bcc:
Subject: fwd: AASERT Final Report
Attachment:
Date: 10/18/96 10:12 AM

Original text
From Bill Kath <kath@asp.esam.nwu.edu>, on 10/15/96 9:38 AM:
To: "Arje Nachman" <arje.nachman@afosr.af.mil>

> The Sept report I require isn't meant to cover AASERTs. Indeed the
> latter is a legal subset of a regular grant. Since you'll be given an
> extension til 15 Sept you might hold off sending me what you just sent
> me until then and call it a Final.

Arje,

Here is the final report for the AASERT.

Best regards,

- Bill Kath

The Modeling of High-Speed Nonlinear Optical Communications

AFOSR FY93 AASERT Grant F49620-93-1-0485

Final Technical Report
1 September 1993 - 31 September 1996

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OBJECTIVES

Ms. Anne Niculae has been studying the mathematical modeling of technologies which can facilitate high-bandwidth optical communications, specifically:

- the modeling of novel phase-sensitive amplifiers (PSAs) for long-distance pulse propagation in nonlinear optical fibers

o the modeling of timing jitter in erbium-doped fibers lasers mode-locked by an input bit stream.

STATUS OF EFFORT

Ms. Niculae has developed a great deal of expertise concerning the modeling of pulse propagation in nonlinear optical fibers and related applications, such as erbium-doped fiber lasers. Her research is complete and she defended her thesis during September, 1996. She will remain at Northwestern during the 1996-1997 in a part-time teaching and research position. She has a number of publications which have either already appeared or will be submitted shortly, and has presented her work at a number of national and international meetings. Her efforts have begun to break new ground in a number of areas (particularly in the modeling of timing jitter in erbium-doped fiber lasers), and it is planned that research in these areas will continue in the coming year.

ACCOMPLISHMENTS/NEW FINDINGS

High-speed optical pulse propagation in nonlinear optical fibers is governed by the nonlinear Schroedinger (NLS) equation, which describes how the fiber's dispersion is compensated by the self-phase modulation induced by the nonlinearity; the result is pulses which nominally propagate without change of shape, called solitons. Perturbations can destroy solitons or their ability to carry information errorlessly, however, so that in many cases controlling of optical solitons to reduce the effect of the perturbations becomes necessary. We have been exploring the use of phase-sensitive amplifiers (PSAs) to provide such control.

Ms. Niculae has examined the case where feedback techniques are used to set the PSA phase, which is a more realistic model of the real experimental situation. Ms. Niculae has shown that PSAs retain the majority of their controlling behavior in this case, thus further demonstrating that the remaining hurdles to a successful implementation of a PSA-based device are more of a technical nature, rather than a conceptual one. More work still needs to be done, however, to determine if such devices can be made practicable.

Ms. Niculae has also begun studies of timing jitter reduction in an erbium-doped fiber laser mode-locked by an input bit stream, with good agreement between her analytical prediction and the numerical simulations. Such a laser (which has been built at British Telecom Labs) can be used to re-time an input signal as the front end of an all-optical switching device. Our desire is to improve the models to the point where they can provide significant a priori information about the performance characteristics of such devices.

PERSONNEL SUPPORTED

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PERSONNEL SUPPORTED

None

* Post-Docs

None

* Graduate Students

Ms. Anne Niculae

* Other (please list role)

Mr. Arnold Kim (undergraduate research assistant)

PUBLICATIONS

* SUBMITTED

* Books/Book Chapters

* Journals (to be submitted)

Timing jitter reduction in a laser mode-locked by an input bit-stream, to be submitted to Optics Letters (Anne Niculae and William L. Kath).

Analysis of pulse propagation in nonlinear optical fibers with phase-locked phase-sensitive amplifiers, to be submitted to SIAM J. on Applied Mathematics (Anne Niculae and William L. Kath).

* Conferences

* ACCEPTED

* Books/Book Chapters

* Journals

Stabilizing dark solitons by using periodic phase-sensitive amplification, Optics Letters, v. 21 (1996), pp. 465-476 (Arnold D. Kim, William L. Kath and Christopher G. Goedde).

Pulse propagation in nonlinear optical fibers with phase-locked phase-sensitive amplifiers, Optics Letters, v. 20 (1995), pp. 557-559 (Anne Niculae and William L. Kath).

* Conferences (Refereed)

Timing jitter reduction in a laser mode-locked by an input bit-stream, Nonlinear Guided Wave Technical Digest, (1996) (Anne Niculae and William L. Kath).

INTERACTIONS/TRANSITIONS

* Participation/Presentations At Meetings, Conferences, Seminars, Etc

bit-stream, Nonlinear Guided Wave Conference, Cambridge, England, August, 1996.

Timing jitter reduction in a laser mode-locked by an input bit-stream, Workshop on Mathematical Methods in Nonlinear Optics, Basic Research Institute in the Mathematical Sciences, Hewlett-Packard Laboratories, Bristol, England, September 1996.

Soliton control in nonlinear optical fibers using parametric amplification, Workshop on Nonlinear Optics, Arizona Center for Mathematical Sciences, University of Arizona, Tucson, Arizona, October 1995.

Pulse propagation in nonlinear optical fibers with phase-locked phase-sensitive amplifiers, Conference on Applications of Dynamical Systems, sponsored by the Society for Industrial and Applied Mathematics, Snowbird, Utah, May 1995.

Pulse propagation in nonlinear optical fibers with phase-locked phase-sensitive amplifiers, Society for Industrial and Applied Mathematics Annual Meeting, San Diego, California, July 1994.

* Consultative And Advisory Functions To Other Laboratories And Agencies

* Transitions

NEW DISCOVERIES, INVENTIONS, OR PATENT DISCLOSURES

None.

HONORS/AWARDS